

# Why Trees Need Salmon

Ecologists have long known that salmon in the Pacific Northwest need clear streams to breed, and that clear streams need healthy forests. Surprising new evidence now indicates that forests themselves need salmon to remain healthy.

Pacific salmon (*Oncorhynchus* spp.) are anadromous: they hatch in freshwater lakes and streams, spend much of their lives at sea, then return to the stream where they were born to breed and die. To reproduce successfully, these fish require clear, cold, shaded streams and a clean gravel riverbed. When forests are cut, sediment washes down hillsides and into streams, clogging gravel streambeds and suffocating eggs. Sediment also absorbs sunlight, warming water and reducing oxygen saturation in the water. Lower oxygen level reduces survival rates of eggs and young fish.

Every year, as millions of fish return to spawn and die, they provide a banquet for bears, eagles, and other species that gorge themselves on the fat-rich fish. Ecologist Thomas Reinchen has found that bears fishing in British Columbia's rivers can catch 500 fish in a six-week salmon migration season (about 12 fish per bear per day). He also estimates that a bear gets 70 percent of its annual protein intake from fish. But bears also drag tons of fish up on shore and leave half-eaten carcasses strewn about the forest floor. Reinchen calculates that these scattered fish fertilize the forest at a rate of about 120 kg of nitrogen per acre. British Columbia's rainforests, with at least 30,000 fishing bears, may receive 60 million kg of salmon each year. Nitrogen is often a limiting nutrient for rainforest vegetation. Between one-quarter and one-half of the nitrogen in a towering Sitka Spruce or Douglas Fir may derive from salmon carcasses.

In addition to fertilizing trees, salmon carcasses provide food for insects and other scavengers. Birds and other predators consume

these insects, and nutrients from salmon thus work through the entire forest ecosystem.

In a separate study, ecologists Robert Naiman and James Helfield found that trees along salmon-rich rivers can grow up to three times as fast as trees along streams without salmon. This is important, they point out, because salmon stocks are dwindling throughout the Pacific Northwest. In Washington, Oregon, and California, salmon populations have fallen by 90 percent from their historic numbers. Because of this close relationship, they argue, forest management and fish management need to be integrated. Each population—rainforest trees and ocean-going fish—affects the stability of the other.

Apparently, salmon need healthy forests, and forests need healthy salmon populations. Stream ecosystems need standing trees to retain soil and provide shade. So healthy streams depend on fish, just as the fish depend on the streams. As this case shows, links among organisms in an ecosystem are intricate, often subtle, and essential for ecological stability. Relationships between apparently separate environments, such as rivers and forests, can be equally important. In this chapter we'll explore some of these relationships among organisms and between organisms and their environment.

## To read more:

Reinchen, T. E., D. Mathewson, M. D. Hocking, J. Moran, and D. Harris. 2003. Isotopic evidence for enrichment of salmon-derived nutrients in vegetation, soil and insects in riparian zones in coastal British Columbia. *American Fisheries Society Symposium* 34:59–69.

Helfield J. M., and R. J. Naiman. 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity. *Ecology* 82(9):2403–09.